D' cmcl'd submicroscopic energizing and energizable elements (molecules, atoms, nuclei, nuclear particles, electrons, photons, antiprotons, etc.). The invention also relates to the use of forces such as electromagnetic or nuclear to impart a third-time derivative or oscillatory motion to a mass consisting of a collection of submasses or mass-pairs of energizable elements such as target nuclei.

Please replace the paragraph beginning at page 2, line 6 with the following rewritten paragraph:

D2

The general concept of the present invention is to simulate or emulate GW generated by energizable celestial systems (rotating binary stars, star explosions, collapse to black holes, etc) by the use of micro, terrestrial energizable systems. Such terrestrial systems generate well over 40 orders of magnitude more force intensity (nuclear or electromagnetic compared to gravitational) and well over 12 orders of magnitude greater frequency (THz compared to 1 Hz or a small fraction of 1 Hz) than the celestial systems. Terrestrial energizable systems produce significant and useful GW according to the various embodiments of the present invention, even though they are orders of magnitude smaller than extra-terrestrial, celestial systems. In the various embodiments of the present invention the large number of small energizable elements are energized in a sequence or in concert by energizing elements emulating the motion of a much larger and extended body having a larger radius of gyration in order to enhance the generation of GW. The laboratory generation of GW was discussed by Pinto & Rotoli in *General Relativity and Gravitational Physics*, 1988, World Scientific, Singapore. They found (page 560) terrestrial laboratory GW generation to be "...at the limit of the state of the art...", but they did not consider submicroscopic, specifically nuclear particles and associated forces and did not discuss the jerk mechanism for generating GW or computer control.

Application No. 09/752,975

Please replace the paragraph beginning at page 4, line 13 with the following rewritten paragraph:

D3

The present invention provides the generation of gravitational waves (GW) caused by the interaction of submicroscopic (molecules, atoms, nuclei, nuclear particles, electrons, photons, etc.) energizing and energizable elements. This interaction involves electromagnetic forces or nuclear forces. The important feature of the interaction is that the inertial mass of the energizable elements, taken as a whole, is caused to jerk or harmonically oscillate and thereby generate GW. A presently preferred embodiment of the present invention utilizes strong nuclear forces that are attendant to a nuclear reaction triggered or energized by the impact of a submicroscopic energizing particle, such as a photon, electron, proton, neutron, antiproton, alpha particle, etc. from a high-frequency pulsed particle beam incident on a target mass composed of energizable elements such as atomic nuclei. In the preferred embodiment, the nuclei are aligned or constrained as to spin or some other nuclear condition by being placed in an electromagnetic field, in a superconducting state, spin polarized, etc. This results in the products of all of the nuclear reactions being emitted in the same preferred direction. Each emission results in a recoil impulse on the nuclei or a rapid build up of force that jerks the nuclei or causes them to harmonically oscillate and results in an emission of gravitational waves or wave/particles also called "forceons" or "massons." The particles in the beam are chopped into very small bunches, that is, with, for example, GHz to THz frequency, so that a very rapid force build up or jerk is produced in the target mass, that is, in the target nuclei, resulting in a GW exhibiting the chopping frequency. The impulse can also be accomplished without nuclei alignment by other means, such as molecular or high-energy nuclear beam particle collision with unaligned target nuclei or by impressing a high-frequency magnetic field on a high-temperature superconductor.

D3 cmcld

Since gravitational waves in, for example, a superconductor move significantly slower than light speed, the particles of the beam can be accelerated to this GW speed and move through the ensemble of target nuclei, which compose the target mass, in step with the forward-moving or radially-moving gravitational wave. Thus, the forward-moving or radially-moving gravitational wave (GW) builds up amplitude as the particles of the beam move through the target particles in concert to generate coherent GW and emulate a much larger target mass. By varying the number of particles in each bunch of particles in the particle beam and the chopping frequency, both the beam and the gravitational waves produced by it can be modulated and carry information. The target mass or collection of target nuclei can be a solid, a liquid (including a superfluid such as liquid helium II), a gas (including an electron gas)or other particle collection.

Please replace the paragraph beginning at page 9, line 23 with the following rewritten paragraph:

D4

In FIG. 3C, which is at time 2Δt later, the GW 43 emanating from the first particle 40 and the second particles 44 are reinforced by another set of particles 46 and their attendant GW 47. FIG. 3D is at time 3Δt and typical target-mass particles 48 add their GW 49 to the accumulating and radially expanding GW. Each arriving beam bunch initiates additional expanding rings of coherent GW until the target-mass particles are exhausted or until their replacements are unavailable. There are large numbers of energizable particle sites that are simultaneously energized so that the GW permeates the target mass as the GW are superimposed. As noted by Pinto & Rotoli (op cit, p. 567) "...the quadrupole formula is only valid provided a suitable surface integral vanish(es), which is the case for an assembly of point sources,...".

Please replace the paragraph beginning at page 11, line ~~26~~ 15 with the following rewritten paragraph:

D5

In FIG. 5, of the preferred embodiment a particle source 15, which could be a laser or a nuclear reaction, produces particles that can be accelerated by an acceleration device 16 (unless the particles are photons), focused by a focusing device 17 such as a superconducting medium or electromagnetic field and separated into bunches by a beam chopper 18. The target mass can be a solid, a liquid (including a superfluid such as liquid helium II), a gas (including electron gas), or another particle beam. Alternately, the beam can be separated into bunches and modulated as to frequency and number of particles in each bunch at the particle source 15. The particle source 15 or beam chopper 18 is controlled by computer 19, an information-processing device 20 and transmitter 71. The particle beam bunches 1 impact the target particles 9 and produce a nuclear reaction, generating GW 21, which can be received at receiving device 70. The information processing device 20 can be, for example, a Kalman filter and/or a table look up for identifying the element to be energized.

Please replace the paragraph beginning at page 14, line 14 with the following rewritten paragraph:
graph:

The present invention relies upon the fact that the rapid movement or jerk or oscillation of a mass or collection of submicroscopic particles such as nuclei will produce a quadrupole moment and generate useful high-frequency, for example, up to Quadrahertz (QHz)or higher frequency, GW. The device described herein accomplishes GW generation in several ways based upon the interaction of energizing and energizable submicroscopic particles.

Please replace the paragraph beginning at page 15, line 13 with the following rewritten paragraph:

The target will exhibit an absorption thickness, that is, a length over which many of the impacting particles interact with the target nuclei to produce a nuclear reaction whose collision products move in a preferred direction resulting in a jerk or oscillation.

Please replace the paragraph beginning at page 20, line 34 with the following rewritten paragraph:

The specific relationship for GW generation by energizing elements, such as particle-beam particles, colliding with energizable elements, such as aligned target nuclei, will be an outcome of the use of the present invention described herein. To better understand that relationship, it is helpful to refer to the standard quadrupole approximation, Eq. (110.16), p.355 of L.C. Landau and E.M. Lifshitz, The Classical Theory of Fields, Fourth Revised English Edition, Pergamon Press, 1975 or Eq. (1), p.463 of J.P. Ostriker, ("Astrophysical Source of Gravitational Radiation" in Sources of Gravitational Radiation, Edited by L.L. Smarr, Cambridge University Press, 1979) which gives the GW radiated power (watts) as

$$P = -dE/dt = -(G/45c^5)k\ (d^3D_{d\beta}/dt^3)^2 \text{ (watts)} \quad (1)$$

where

E = energy [joules],

t = time [s],

$G = 6.67423 \times 10^{-11}$ [m^3/kg-s^2] (universal gravitational constant, not the Einstein tensor),

$c = 3 \times 10^8$ [m/s] (the speed of light), and $D_{d\beta}$ [kg-m^2] is the quadrupole moment-of-inertia tensor of the mass of the target particles, and the δ and β subscripts signify the tensor components and directions. The quantity $(d^3D_{\alpha\beta}/dt^3)^2$ is the kernel at the quadrupole approximation.

Equation (1) can also be expressed as:

$P = GK_{I3dot}\underline{(d^3 I/dt^3)^2/5c^2\ (\text{watts})}$ (2)

where $I = (\Sigma m)r^2$ [kg-m2], the moment of inertia,

(Σm) = sum of the masses of the individual target nuclei that are impacted by the particle beam, expel nuclear-reaction products, and caused to jerk or recoil in unison, (kg), (or, at least jerk or oscillate as the forward-moving GW front moves by),

r = the effective radius of gyrations of the ensemble of target nuclei that constitute the target mass (m), and K_{I3dot} = a dimensionless constant or function to be established by experiment.

Please replace the paragraph beginning at page 23, line 13 with the following rewritten paragraph:

With $K_{13dot} = 32$, as in the case of the GW radiated by the centrifugal-force jerk of a spinning rod, from Eq.(1), p.90 of Joseph Weber (1964), "Gravitational Waves" in Gravitation and Relativity, Chapter 5, W.A. Benjamin, Inc., New York and Introducing Eq.(5), Eq.(2) becomes

$P = 1.76X10^{-52}\ (n\ 2r\ \Delta\ f_n/\Delta t)^2$ (watts). (6)

The number of particles in a typical bunch is estimated to be approximately that of the Stanford Linear Collider (SLC) or 4x10" particles. It is estimated that 10% of the particles impact target nuclei and result in nuclear reaction (that is, a 10% harvest), so $n = 4x10^{10}$. Inserting these numbers into Eq.(6) we have

$P = 1.76410^{-52}\ (4x10^{10}x2x0.01\ \Delta\ f_n/\Delta t)^2$ (watts) (7)

and, subject to further verification as to the mass defect and impulsive nuclear force, that is verification of the magnitude of the jerk, we take $\Delta\ f_n = 1x10^{-6}$ [N] and $\Delta t = 10^{-12}$ (s) resulting in

$P = 1.13x10^{-22}$ (watts).

The reference area is either the rim of a disk one centimeter thick and one centimeter in diameter or $3.14x10^{-4}$ (m^2) for a GW flux of $3.6x10^{-19}$ (watts/m2) for a harmonic oscillation of the target elements or one square centimeter for a linear jerk of the target elements

(there is a factor of 0.5 since the GW is bifurcated -- half moving in the direction of the jerk and half in the opposition direction). The former leads to a forward component of GW flux of 5.65×10^{-19} (watts/m^2). A lens system composed of a media in which the GW is slowed (such as a superconducting media) could concentrate or focus the GW from, say, a one square centimeter, to 10 micrometer^2 for an increase in GW flux of 10^6 to 5.65×10^{-13} (watts/m^2). Note that in the refraction medium the GW wavelength is significantly smaller than 10 (micrometers) at THz frequencies, so that GW diffraction, if present, is not very significant. All of the foregoing quadrupole equations are approximations to P. Due to the slowness of the GW, about one hundredth of light speed, the GW wavelength in the superconducting target is about λ_{GW} $0.01c\Delta t = 3\times10^6\times10^{-12}=3\times10^{-6}$(m), but still larger than the radius of the target nuclei, beam particles, or nuclear-reaction products, so λ_{GW} is much greater than the radius of the target particles and also due to the slow GW propagation speed, all speeds are much less than c. Thus the quadrupole approximation is good, but still K_{I3dot} will be further refined as will the harvest and other details of the energizing and jerk-producing or harmonic-oscillation-producing mechanism of the invention such as Δf_n and Δt.

Please replace the paragraph beginning at page 28, line 9, with the following rewritten paragraph:

There is a fundamental difference between photons, gravitons, gluons, etc., and forceons or massons. The former are manifested by the curvature of the multidimensional STU fabric created by the attractions or forces associated with charge, mass, nuclear particles, etc. (all conjectured to be similar to gravity, that is, not really "forces", but motion along convergent or divergent geodesics in the multidimensional STU), whereas the latter is manifested by the rapid changes in the forces or jerk or oscillation associated with the former - like "cracking a whip" or "striking a drum head" of STU